Noise and Vibrati n Mitigating Mat

Field of the Invention

The present invention is related to a sound absorbing material, and more particularly to a sound absorbing mat for mitigating impact generated and structure borne noise.

Background of the Invention

In many situations, noise is generated on horizontal surfaces such as floors or road surfaces due to various impacts. For example, a truck passing over a road generates impact noise. Such impact noise typically travels through the road and then to adjacent structures. Likewise, machinery which generates vibrations during use may generate impact or vibrational noise which passes through the floor and into adjacent structures. In yet another example, locomotives and railcars passing over a track generate impact and vibrational noise which passes into the ground and potentially into adjacent structures such as homes, roads or bridges. Mitigating this noise is especially problematic due to the relatively large axle loads of the locomotives and railcars on the tracks.

Such impact noise and vibrations generated under these and similar conditions have been found to be undesirable due to the noise and vibration pollution created in adjacent and surrounding structures. It is therefore desirable to mitigate the affects of impact and vibrations on surrounding structures.

Summary of the Invention

A multi-layer noise mitigating mat is provided by the present invention. A first layer is formed of bound rubber and features a profiled surface forming a bottom surface of the mat and

a flat surface opposite the profiled surface. A second layer consists of a fabric or reinforcing agent which is affixed to the first layer along its flat surface. A third layer formed of bound rubber is affixed to the second layer forming the top surface of the mat.

Brief Description of the Drawings

The invention will now be described by way of example with reference to the accompanying figures of which:

Figure 1A is a partial side view of the noise mitigating mat according to the present invention.

Figure 1B is a detailed cross sectional view of the noise mitigating mat according to the present invention.

Figure 2 is a cross sectional view of the noise mitigating mat of Figure 1 installed in a railway bed application.

Detailed Description of the Preferred Embodiments

Referring to Figures 1A, 1B and 2, the mat 10 has a bottom surface 12 and a top surface 14, which extend between a pair of sides 22. The mat 10 can be produced in a continuous role such that the surfaces 12, 14 extend for a distance between the sides 22. The top surface 14 and the oppositely facing bottom surface 12 are essentially parallel to each other and spaced apart by an overall thickness t. The bottom surface 12 is contoured such that the overall thickness is measured at the maximum dimension of the contour while the thickness over the bottom surface 12 varies between a minimum thickness t_1 and the overall thickness t. As the mat is manufactured in continuous sheets, the length of the mat 10 will be governed by the particular

installation. This provides maximum flexibility during installation. The use of a continuous sheet provides advantages which will be more fully described below.

An installation of the mat 10 according to the present invention is shown in Figure 2 wherein the mat 10 is placed in a railway bed. The railway bed consists of a packed earth, asphalt or concrete base 30 which is topped with the noise and vibrating mitigating mat 10, ballast 40, railway ties 50, and rails 60. During the installation of the railway bed, a continuous roll of the mat 10 is staged to be unrolled in a continuous manner over the packed earth base 30. This may be accomplished through the use of spooling machinery. Since the rubber material of the present invention has not been vulcanized, the rubber material has the flexibility required to allow it to be delivered in rolls. With the mat 10 properly positioned on the packed earth base 30, the ballast 40, ties 50 and rails 60 may then be applied in a conventional manner.

The mat 10 consists of three layers between the bottom surface 12 and top surface 14. The first layer 16 is formed of recycled bound rubber products and is contoured on the bottom surface 12 and flat along its top surface 13. The second or intermediate layer 18 is formed of fabric or reinforcing agent such as EE200-80 polyester polynylon blend which is commercially available from several sources such as Allied Signal and is a relatively flat material having a thickness extending between the first layer 16 and the third layer 20. The third layer 20 is also formed of recycled rubber products and extends between the top surface 14 and the intermediate layer 18.

The first and third layers 16, 20 are manufactured from recycled rubber. During the manufacturing process Styrenebutadiene Rubber (SBR) and natural rubber are mixed with a polyurethane and cured under moderate temperature to form a large cylindrical member of rubber. Although each layer 16, 20 has a large percentage of SBR rubber therein, the mat 10 can

be made of SBR rubber, other rubbers or a combination thereof. In order to provide a continuous sheet of material for each layer 16, 20, it is cut from the large cylindrical member. As the cylindrical member is rotated, blades engage an outside layer of the cylindrical member and cause the outside layer to be cut away from the cylindrical member thereby forming the respective continuous sheet. This process of manufacturing each layer 16, 20 in the form of a continuous sheet is significantly different than known vulcanizing methods generally used to manufacture materials of this type. In manufacturing the mat 10, first and third layers 16, 20 are each manufactured having a desired number of voids which are randomly positioned within each layer. The material for the first layer 16 has a relatively low density as compared to the material for the third layer 20 and therefore has more voids. The third layer 20 is relatively more dense than the first layer 16 and contains fewer voids. The density of each layer is selected to result in a desired ratio of dynamic stiffness to static stiffness in the mat 10. This ratio is selected to result in a desired dynamic compression or deflection of the mat 10 under load. The contour of the surface 12 also contributes to the dynamic compression characteristics of the mat 10 as will be further described below.

After the first layer 16 is cut from the large cylindrical member of rubber, it is placed in a profiling machine that physically cuts or otherwise applies the required depth and pattern of the profile into the rubber. One such profile is shown in the cross sectional view of Figure 2. It should be understood that the resultant surface 12 may take many forms including ones that are relatively flat and ones that have large variation in thickness between t_1 and t. The example in Figures 1 and 2 shows the surface 12 in the form of an egg crate wherein peaks and valleys are sequentially alternated in a three dimensional array forming the bottom surface 12. The depth and pitch of the peaks and valleys can be varied to give a desired dynamic compression

characteristic. For example, sharp peaks and valleys offer greater dynamic compression or deflection under relatively small loads while wide short peaks and valleys result in less dynamic compression or deflection under relatively larger loads. The profiled surface geometry is therefore selected to result in a desired amount of compressive deflection under a given dynamic load. This dynamic compressive deflection serves to mitigate transfer of structure borne or impact noise from the rail 60 into the packed earth base 30 (Figure 2). For example, a freight rail car of 40 tons requires a stiffer mat. Here the profile would consist of relatively wide short peaks and valleys.

The three or more layers 16, 18, 20 are then assembled either through a lamination machine or through a machine that mechanically or chemically bonds the layers together. The third layer 20 advantageously prevents ballast stone penetration and the second layer 18 advantageously ensures uniform load distribution. The profiled bottom surface 12 advantageously provides generous drainage to the system.

The use of the mat 10 has various advantages over the prior art. The impact and sound absorption properties of the mat 10 prevent fouling of the ballast due to impact and vibration. Ballast fouling contributes to poor drainage and flooding of the railway bed. The contoured surface 12 provides not only good absorption and vibration absorption but also allows for effective drainage and preserves the ballast from fouling or degrading due to impact.

The foregoing illustrates some of the possibilities for practicing the invention. Many other embodiments are possible within the scope and spirit of the invention. It is, therefore, intended that the foregoing description be regarded as illustrative rather than limiting, and that the scope of the invention is given by the appended claims together with their full range of equivalents.